

A NEW SPECIES OF *FRUMENTA* BUSCK (LEPIDOPTERA: GELECHIIDAE:
GNORIMOSCHEMINI) FROM MÉXICO: A POTENTIAL BIOCONTROL
AGENT AGAINST *SOLANUM ELAEAGNIFOLIUM* (SOLANACEAE)

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Abstract.—*Frumenta solanophaga*, new species, is described from San Luis Potosí, México. It was reared from *Solanum elaeagnifolium* Cavanilles (Solanaceae) as part of a survey for potential biocontrol agents against this introduced weed in southern Africa. *Frumenta* also includes two previously described species from southern United States; the group appears to feed exclusively on *Solanum*. Photographs and illustrations of *F. solanophaga* depict the imago, wing venation, intersegmental abdominal lobes of the female, and male and female genitalia. A key to the species of *Frumenta* is provided.

Key Words: Gelechiidae, *Solanum*, biocontrol

Frumenta was proposed by Busck (1939) to accommodate the single species, *Gelechia nundinella* Zeller, 1873. Hodges (1983) synonymized *Gelechia beneficentella* Murtfeld, 1881, with *Gelechia nundinella* and transferred *Asapharcha nephelomicta* Meyrick, 1930, to *Frumenta*. Since then, the genus has included only the two aforementioned species, which are known only from the United States. The genus belongs to the tribe Gnorimoschemini.

Since its description, *Frumenta nundinella* has been known as a herbivore of the noxious weed, horse-nettle (*Solanum carolinense* Linnaeus; Solanaceae), and the moth has been cited repeatedly as a potential biological control agent against this weed in the United States and Canada (e.g., Murtfeld 1881; Forbes 1923; Foott 1967; Bailey and Kok 1976, 1982; Bailey 1977). Solomon (1980, 1981, 1983) presented details of the life history of *F. nundinella*, including hosts and herbivore relationships

and phenology. *Frumenta nephelomicta*, which galls the stems and fruit of *S. elaeagnifolium* Cavanilles, was released for the biological control of this weed in South Africa (Neser et al. 1990).

During recent efforts to discover new potential biological control agents against *Solanum elaeagnifolium*, specimens of a undescribed species of *Frumenta* were reared in San Luis Potosí, México, by personnel associated with the Plant Protection Research Institute, Pretoria, South Africa, and sent to the Systematic Entomology Laboratory, USDA, for identification. The purposes of this paper are to describe this new species and to summarize information on host plant usage in *Frumenta* in general.

Adult vestiture was examined using an incandescent light source (reflected light). Kornerup and Wanscher (1978) was used as a color standard for the description of *Frumenta solanophaga*. Genitalia were dissected as described by Clarke (1941), except



Fig. 1. Holotype of *Frumentia solanophaga*.

the ventral part of the male genitalia was separated from the dorsal part on one side. The free part then was swung across the tegumen and mounted flat. Mercurochrome and chlorazol black were used as stains. Slide preparations were examined with dissecting and compound microscopes. Terminology for genitalia and wing venation follows that of Polvolný (1991) and Powell and Polvolný (2001).

KEY TO ADULTS OF *FRUMENTA*

- 1. Forewing white, intermixed with pale-yellow scales, with few small, pale-brown discal and marginal spots *nephelomicta*
- Forewing pale gray, intermixed with pale-yellow scales, with many large gray discal and marginal spots 2
- 2. Male 3
- Female 4
- 3. Valva beyond basal arch long, gnathos about ½ width of base of uncus (Fig. 3) . . . *solanophaga*
- Valva beyond basal arch short, gnathos about ¼ width of base of uncus *mundinella*

- 4. Ductus bursae about three times length of apophyses anteriores; apophyses anteriores narrow throughout length *mundinella*
- Ductus bursae about two times length of apophyses anteriores; apophyses anteriores dilated basally (Fig. 5) *solanophaga*

***Frumentia solanophaga* Adamski and Brown, new species**
(Figs. 1–5)

Diagnosis.—*Frumentia solanophaga* is superficially most similar to *F. mundinella*, but it is genitally most similar to *F. nephelomicta*. *Frumentia solanophaga* shares with *F. nephelomicta* the following: valva elongate-rectangular beyond the basal arch; gnathos widened in distal junction of arms; and basal half of the apophyses anteriores dilated. *Frumentia solanophaga* differs from *F. nephelomicta* by having a darker forewing pattern, deeper basal arch of valva, distally wider valva, a longer aedeagus, and stouter apophyses anteriores.

Description, adult.—*Head*: Vertex and frontoclypeus pale yellowish brown or pale gray; scape pale gray, intermixed with pale-brown scales, flagellum gray; outer surface of labial palpus pale brown, intermixed with white scales, inner surface white; proboscis white.

Thorax: Tegula and mesonotum pale yellowish brown; legs with gray scales narrowly tipped with pale yellow, tarsomeres banded with pale yellowish-brown scales apically. Forewing (Figs. 1–2): Length 10.0–12.2 mm (mean = 11.6; n = 9). Ground color pale yellowish brown, intermixed with white and few pale-gray scales; darker gray and brown scales, each tipped with pale yellow form small costal spots, 2–3 larger, irregularly shaped discal spots, and large submarginal spots; in some specimens ground color as above with area posterior to CuP gray, or wing gray, intermixed with few pale yellow scales. Venation with R_4 – R_5 stalked about $\frac{2}{3}$ distance from cell; anterodistal part of cell slightly attenuate; R_5 and medial veins divergent; CuA_1 – CuA_2 long, nearly parallel. Undersurface with gray scales, narrowly tipped with pale yellow, intermixed with pale-yellow scales near apex. *Hindwing* (Figs. 1–2): Shiny gray. Venation with $Sc + R_1$, R_s , and M_1 divergently arched from M_2 and M_3 ; $Sc + R_1$ and radial branch connected by a short cross vein near $\frac{1}{3}$ length of cell; distal margin of cell concave inwardly; R_s and M_1 originating near anterodistal part of cell, slightly divergent, each juxtaposed to apex; M_2 closer to M_3 at base, arching closer to M_1 from $\frac{1}{3}$ length to margin; CuA_1 – CuA_2 subparallel.

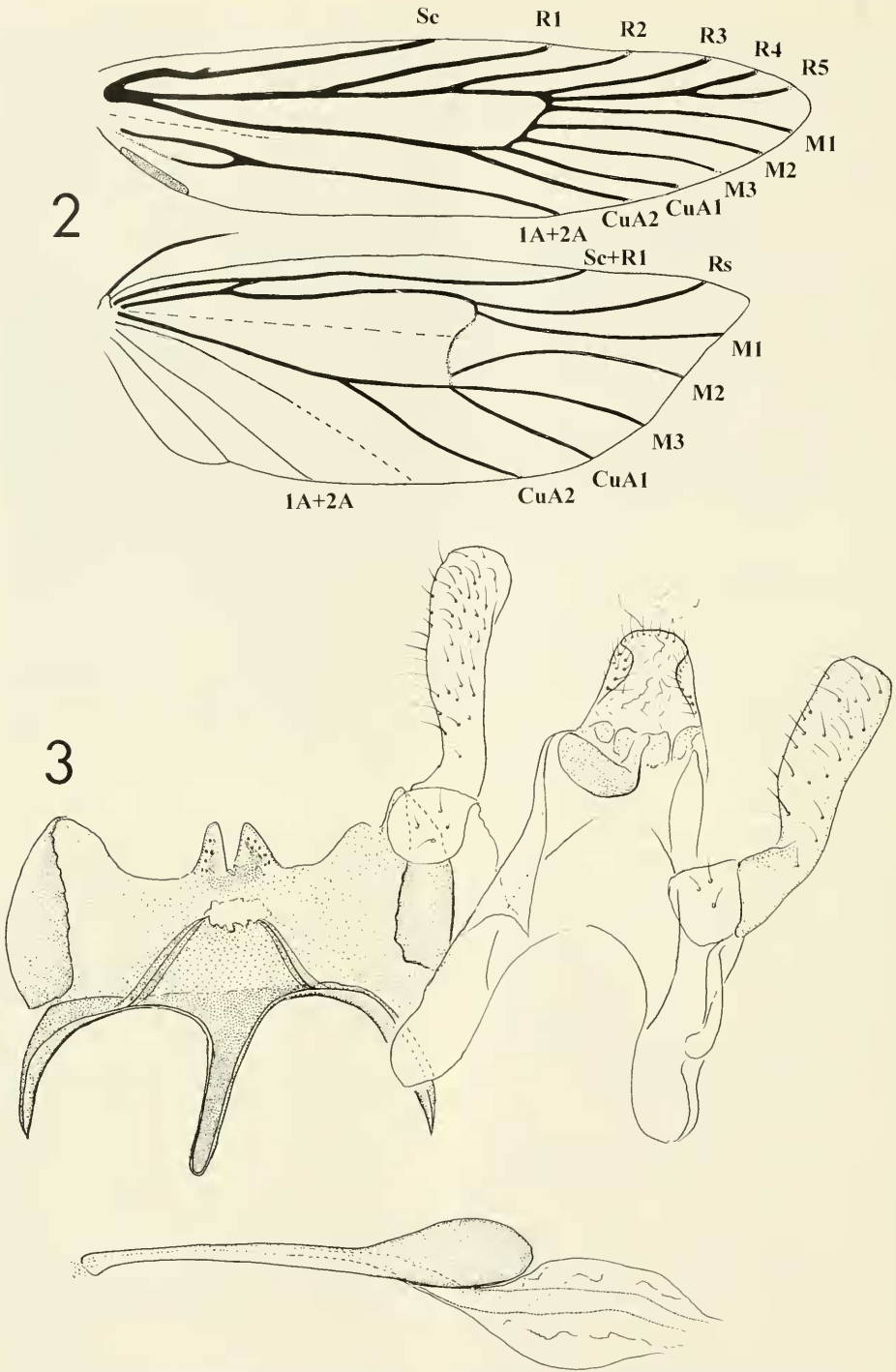
Abdomen: Pale gray scales, intermixed with white scales; male terga 1–3 with brownish-orange scales; female intersegmental membrane with large lateral lobe anterior to spiracle on seventh segment (Fig. 4). *Male genitalia* (Fig. 3): Uncus trapezoidal, lateral margins slightly curved ventrally, setose submarginally; gnathos elongate, flat, rounded apically; valva short, slightly narrowed submedially, distal lobe

sparsely setose, blunt apically; vinculum elongate, acutely curved anterolaterally; aedeagus elongate, bulbous at base, parallel-sided and narrow distally. *Female genitalia* (Fig. 5): Papillae anales with long setae intermixed with short setae; apophyses posteriores slender; eighth sternum and tergum fused forming a sclerotized ring, extended anterolaterally into a pair of broad apophyses anteriores, and extended ventromedially, forming a broadly rounded, shallowly invaginated antrum; ductus bursae elongate, swollen near inception of ductus seminalis; swollen area with a small, internal, semi-circular support; corpus bursae elongate, wider anteriorly than posteriorly, with an elongate signum on posterior end.

Holotype.—♂, “MÉXICO, San Luis Potosí, San Luis de la Paz, 21.19N, 100.32W, 10.ix.1999, H. G. Zimmermann, AcSN 2109,” “Emerged in quarantine from berries of *Solanum elaeagnifolium* (Solanaceae). Larvae eat seeds and flesh,” “National Collection of Insects, Pretoria, S[outh] Afr[ica].” Holotype not dissected. Deposited in the National Museum of Natural History Museum, Smithsonian Institution, USA [USNM].

Paratypes.—5 ♂, 3 ♀, same label data as holotype, except, “♂ genitalia slide by D Adamski, USNM 81218” [green label], “♂ genitalia slide by D Adamski, USNM 82133” [green label], “♂ wing slide by D Adamski, USNM 82134” [green label], “♀ genitalia slide by D Adamski, USNM 81219” [green label], “♀ genitalia slide by D Adamski, USNM 81220” [green label], “♀ genitalia slide by D Adamski, USNM 82132” [green label]. Five paratypes deposited in USNM; one paratype deposited in the Transvaal Museum, Pretoria, South Africa; one paratype deposited in The South African Museum, Capetown, South Africa.

Etymology.—The specific epithet is derived from the plant genus, *Solanum*, to which the host of *F. solanophaga* belongs, and from the Greek “*phagein*,” meaning, “to eat.”



Figs. 2-3. *Frumenta solanophaga*. 2, Wing venation (male). 3, Male genitalia: genital capsule and aedeagus.

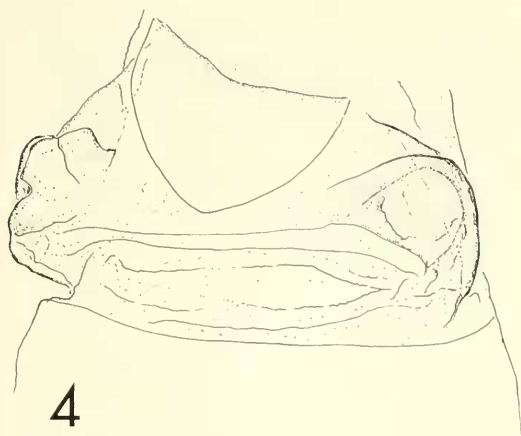


Fig. 4. *Frumenta solanophaga*. Lateral lobes of intersegmental membrane anterior to spiracle of seventh segment (female).

DISCUSSION

Association with Solanaceae.—The larval use of Solanaceae is common in the gelechiid tribe Gnorimoschemini, where many species are known to be pests of solanaceous crops (Povolný 1973, 1975), e.g., *Scrobipalpa absoluta* (Meyrick) on tomato (*Lycopersicon esculentum* Mill.) in northern South America; *Scrobipalpopsis solanivora* Povolný on potato (*Solanum tuberosum* L.) in Central America; *Phthorimaea isochlora* Meyrick on "friegaplato" (*Solanum saponaceum* Duf) in Colombia; *Phthorimaea operculella* Zeller on potato throughout the New World; *Keiferia lycopersicella* (Walsingham) on tomato throughout the New World; *Keiferia colombiana* Povolný on friegaplato in Colombia; and *Symmetrischema tangolias* (Gyen) (= *S. plaesiosema* (Turner)) on *Solanum nigrum* L. in the United States and presumably on *Solanum* in Australia.

Members of *Frumenta* apparently are specialists on the plant genus *Solanum*. *Frumenta mundinella*, which occurs throughout southern and midwestern United States (i.e., Georgia, Illinois, Indiana, Louisiana, Missouri, Pennsylvania, Texas, and Virginia) is widely recognized as an important herbivore of *Solanum carolinense*. *Fru-*

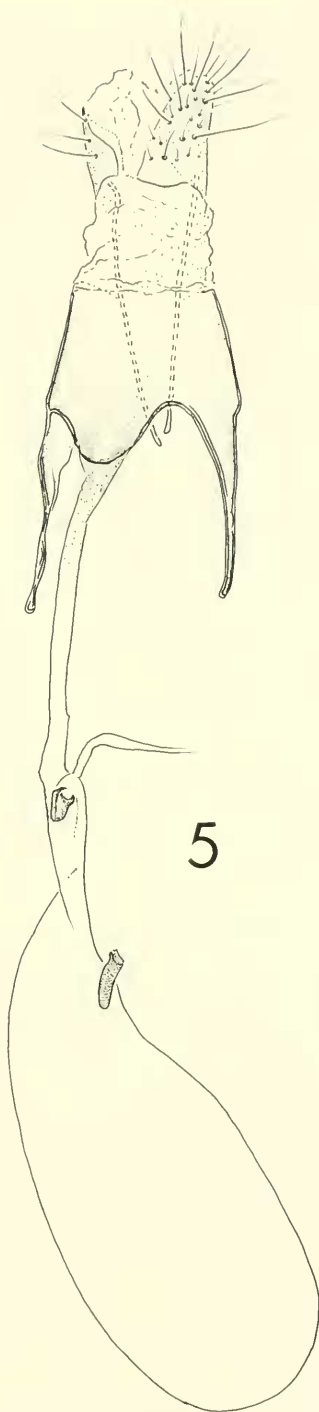


Fig. 5. *Frumenta solanophaga*. Female genitalia.

menta nephelomicta, which is known from Arizona and New Mexico, has been reared from *Solanum elaeagnifolium* and was introduced into South Africa for the biological control of this weed. An apparently undescribed species of *Frumenta* from Texas and New Mexico also has been reared from *S. elaeagnifolium* (specimen data from USNM). The discovery of *F. solanophaga* as a herbivore of *S. elaeagnifolium* adds further support to the hypothesis that the genus is closely associated with *Solanum*.

The biology of *F. solanophaga* is unknown. According to Bailey and Kok (1976), the larvae of *Frumenta nundinella* attack at least two stages of *Solanum carolinense*. They feed on the tips of the young leaves before formation of fruits and pupate in characteristic leaf chambers in mid-July. After the plants fruit in late July, the larvae are fruit borers; one larva is capable of destroying all the seeds within a berry. The larvae pupate inside the berries, emerging as adults in August and September. In contrast, the larvae of *Frumenta nephelomicta* have been described as gallers of stems and fruit (Neser et al. 1990).

Potential use in biological control.—*Solanum elaeagnifolium* goes by a variety of common names, including bull-nettle, silver horse-nettle, white-horse-nettle, silverleaf nightshade, silver-leaf-nettle, trompillo (Brako et al. 1995), and satansbos (the latter used primarily in South Africa). It is a persistent, prickly, perennial evergreen shrub native to the New World (Goeden 1972) that has been introduced inadvertently into southern Africa and Australia, where it has become an economically important weed (Siebert 1975, Wells et al. 1986). It may poison livestock where it occurs in areas used for grazing (Kingsbury 1964, Parker 1990). In South Africa, several studies have been conducted on potential biological controls for *S. elaeagnifolium* (Siebert 1975; Olckers and Hulley 1989a, b, 1991a, b). The status of the biological control of this weed in South Africa is summarized by Neser et al. (1990).

In the mid 1980s *Frumenta nephelomicta* was introduced into South Africa for control of *S. elaeagnifolium*. According to Julien (1987), the insect failed to establish, apparently owing to severe drought and small releases; however, further releases are intended. The source of the specimens of *F. nephelomicta* released was not indicated, but if it was México (rather than southwestern United States), then "*F. nephelomicta*" was most likely a misidentification of *F. solanophaga*. Because of possible differences in feeding habits among species of *Frumenta*, accurate identification of this potential biocontrol organism is critical.

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